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SCIENTIFIC TRUTH AND RELIGIOUS TRUTH

The honour which you have bestowed upon me, and for which I thank you, is linked with the name of Romano Guardini. This makes it particularly dear to me, for the spiritual world of Guardini left a deep impression on me already in my early years. I read his writings as a young person and saw the characters in Dostoevski's work through his eyes, and later in life I had the pleasure of making his personal acquaintance. This world of Guardini's is religious and Christian through and through, and it seems at first difficult to find a link from it to the world of the sciences in which I have worked since my student days. As you know, in the development of the sciences, the opinion has time and again been expressed since the famous trial against Galileo that scientific truth cannot be brought into harmony with the religious interpretation of the world. Although I am convinced of the unassailability of scientific truth in its own sphere, I have never been able to dismiss the content of religious thinking simply as a stage in human consciousness which we have superseded, as a part which we can dispense with in future. So I have continually been forced during my life to ponder on the relationship between these two worlds of the spirit, for I have never been able to doubt the truth of what they are pointing to. I wish first in what I say to deal with the unassailability and value of scientific truth, and then with the much wider sphere of religion (about which, where it touches on the Christian religion, Guardini has written in such a convincing fashion), and finally—and that will be the most difficult aspect to formulate—the relationship of both truths to each other.

The normal account of the beginnings of modern science—i.e. the discoveries of Copernicus, Galileo, Kepler, and Newton, explains that the truth of religious revelations as laid down in the Bible and the writings of the church fathers, which had dominated the thinking of the Middle Ages, was joined at that time by the reality of sensuous experience, which could be tested by everybody in healthy command of his

Werner Heisenberg, a Nobel Prize winner in physics, is the author of THE PHYSICAL PRINCIPLES OF THE QUANTUM THEORY AND NATURAL LAW AND THE STRUCTURE OF MATTER. This article grew out of a talk given in Munich on receiving the 1973 Guardini prize of the Catholic Academy in Bavaria and appeared first in Universitas, a German review of the arts and sciences (1974, vol. 16, no. 1).

five senses and could not be doubted where adequate care was exercised. But this first approach to describing the new thinking is only half right; it neglects some quite essential factors without which we cannot understand the force of this new thinking. Not by chance was the beginning of modern science linked with a rejection of Aristotle and an acceptance of Plato. Already in ancient times Aristotle as an empirical philosopher had charged the Pythagoreans (and we have to consider Plato as one), with failing to look for explanations and theories on the basis of the facts, and playing around with the facts on the basis of certain theories and cherished ideas, and, we might say, seeing themselves as helping to shape the universe. In fact, the new science did lead away from direct experience in the way that Aristotle criticised. We have only to think of the understanding of the movement of the planets. Direct experience teaches us that the earth rests and that the sun moves round it. In more extreme form we would even say that the word “rest” is defined by the statement that the earth rests and that we describe every body as resting which does not move relative to the earth. If the word “rest” is so understood—and this is the generally accepted meaning—then Ptolemy was right and Copernicus was wrong. Only when we reflect on the notions of “movement” and “rest” and understand that movement is a statement about the relation between at least two bodies, can we reverse the relationship and make the sun the immobile centre of the planetary system and gain a much simpler and more unified view of that system, the clarifying force of which was later fully appreciated by Newton. Copernicus thus added a completely new element to direct experience which I shall call here the “simplicity of the natural laws” and which has nothing whatever to do with direct experience. The same can be seen of Galileo’s laws of falling. Direct experience teaches that light bodies fall more slowly than heavy ones. Instead, Galileo claimed that in a vacuum all bodies fall equally fast and that their falling movement is correctly described by mathematically definable laws, Galileo’s laws of falling. It was not possible then to observe movement in a vacuum. The place of direct experience is taken by an idealized form of experience, which turns out to be the right form of idealization, in that it makes mathematical structures apparent in phenomena. There is no doubt that at this early stage of modern science the greatest conviction was borne by the newly discovered laws of mathematics. These mathematics laws were the visible expression of the divine will—this we read in Kepler—and Kepler goes into raptures at the fact that he was the first to recognize the beauty of the divine works. The new thinking, therefore, has nothing whatsoever to do with a rejection of religion. Even if the new findings did run counter to ecclesiastical dogma in some places, this was of little significance if one was able to experience the workings of God in nature so directly.

Of course, the God we are speaking of here is a God of order, and

we do not know whether he is identical with the one to whom we turn in need, to whom we refer our lives. So we can perhaps say that the emphasis was more on one part of the divine workings, bringing with it the danger of losing sight of the total view, the wider context. But this was the very reason for the enormous productiveness of the new science. Philosophers and theologians had been talking so much about the wider context that there was little new to be said on the subject; scholasticism had exhausted the thinking processes. But scarcely anyone had gone into the details of nature events. This was work to which many lesser spirits could contribute, and—there was also the consideration that knowledge of details had some practical use. In some of the learned societies which came into being at that time, discussing observed details, but not the wider context, became almost an enshrined principle. The fact that they were dealing not with direct but idealized experience led to the new art of experiment and measurement as a means of approaching the ideal, producing in its turn the conclusion that it is always possible to reach agreement on the result of experiment. This is not so much the matter of course that it has seemed to later centuries; it assumed that the same thing always happens under the same conditions. Men came to realize that if one can establish certain phenomena through carefully selected experimental conditions shut off from the outside world, then the laws governing these phenomena appear in pure form and the phenomena are determined by a clear causality. This raised trust in the causal course of events, considered as objective and independent of the observer, to a basic postulate of the new science. As you know, this postulate has proved its worth for several centuries, and only recently have we been forced to realize the limits of this method through experience with atoms. Even bearing in mind this experience, we have a seemingly unassailable criterion for truth. The repeatable nature of experiments finally always permits a consensus on the true behaviour of nature.

With this general direction of new science, we see the beginnings of a characteristic feature which has often been discussed later, i.e. the emphasis on the quantitative. The demand for precise experimental conditions and exact measurements, for exact, clear language and a mathematical presentation of ideal phenomena has determined the tenor of this science and given it the name of “exact science.” This name is sometimes used as praise, sometimes the contrary. As praise if the stress is on the reliability, exactitude and unassailability of its statements; as a reproach, if there is a suggestion that it cannot do justice to the great mass of qualitatively different experiences, and that it is too narrow. In our day and age this aspect of science, and the techniques proceeding from it, has come much more to the fore than previously. We have only to think of the extreme demands in precision required for a moon landing and of the almost inconceivable amount of reliability and precis-

ion, to realize to what extent modern science claims to be based solidly on truth.

But of course we have to ask the question: how valuable are these achievements which have been produced with this concentration on one partial aspect and this limitation to one special part of reality? We know that our generation gives conflicting answers to this question. We speak of the ambivalence of science. We have learned that in those parts of the world where there has been a successful link between science and technology, the material misery of the poorer classes has largely disappeared, that modern medicine has prevented the death of millions through diseases, that transport and communications make life easier. On the other hand, science can be abused for the development of weapons of the most terrible destructive power; the primacy of technology harms and threatens our living space. But apart from these direct threats, we have a shift in values; too much is being made of the narrow sphere of affluence, and other basic aspects of life are being neglected. Even if technology and science could only be employed as means to an end, the result depends on whether the aims for which they are being employed are good. The decision on aims cannot be made from inside science and technology; unless we are to go completely astray, it must be made where there is a view of the whole man and his whole reality, not just a small aspect. To this reality belong many things which have not yet been discussed.

First, there is the fact that man can only develop his intellectual powers in relation to a human society. The very qualities which distinguish him from other creatures, his ability to reach beyond the realm of the purely sensory and appreciate that which is beyond, are based on his being part of a community of speaking and thinking beings. History teaches us that such communities not only achieved a physical form, but also a spiritual one, and in those spiritual forms known to us the crucial role has almost always been played by men's attempts to find a meaningful link for the whole, beyond that which is directly visible and perceptible. Only inside this spiritual form, in the "doctrine" valid in the community, has man found guidelines for his own actions, where it is more than just a question of reacting to external situations; it is here that the question of values is first decided. But this spiritual shape not only determines the ethics of a community, but its whole cultural life. Only here do we see the close relationship between the good, the beautiful and the true; only here can we talk of a sense for the life of the individual. We call this spiritual form the religion of the community. This is giving the word religion a somewhat more general meaning than it usually receives. It is meant to take in the spiritual content of various cultures and different ages, even where the notion of God does not occur. Only in the communal forms of thinking which are being aimed at in modern totalitarian states, where the transcendental is com-

pletely excluded, could there be any doubt as to whether the term religion can still be used profitably.

It would be hard to describe better than Guardini has done in his book on the characters in Dostoevski how the form of a human community and the life of the individual in it are stamped by religion. The life of these figures is full of the struggle for religious truth in every moment; it is as it were permeated by the Christian spirit, and so it is of relatively little consequence whether these people are victorious or defeated in the struggle for good. Even the greatest villains among them still know what good and evil are, and they adjust their actions according to the great examples which Christian trust has given them. Here the well-known objection against the Christian religion, that men behave just as terribly inside the Christian world as outside it, loses its validity. Of course it is unfortunately true, but men do retain in the Christian world a clear capacity for distinguishing between good and evil; only where we have this is there any hope of betterment. Where there are no examples to point the way, we lose our scale of values and with it the sense underlying our action and suffering, the final result being nothing but negation and despair. So religion is the basis of ethics, and ethics is the prerequisite of life. For we have to make decisions daily, we must know the values which determine our actions, or at least have an inkling of them.

At this stage we see the characteristic difference between the religious consciousness, in which the sphere of the spirit, the central spiritual order of things, plays a crucial part, and the more limited forms of thinking, particularly of our times, which relate only to the experiential side of a human community. We find such forms of thinking both in the liberal democracies of the West and the totalitarian state systems of the East. Here, too, an ethic is formulated, but with reference only to a norm of moral behaviour, and this norm is derived from observations of direct visible experience. Religion as such does not speak of norms, but of precepts according to which we adapt our behaviour and which we can, even at best, only approach. And these precepts are not based on the directly visible world, but on the realm behind it, which Plato referred to as the realm of ideas, and which the Bible speaks of in the words "God is a spirit."

But religion is not only the basis of ethics; it is, and this we can also learn from Guardini, above all the basis of trust. Just as we learn to speak as children and see in the understanding inherent in language the most important part of trust in people, so the images and parables of religion, which are a kind of poetic language, produce trust in the world and in the sense of our existence. The fact that there are many different languages is no barrier, nor is the fact that we are born seemingly by chance into a certain linguistic or religious community by which we are stamped. What is alone important is that we are introduced to

this trust in the world, and that can happen in any language. For the Russians, for example, who appear in Dostoevski's novels and whom Guardini writes about, the workings of God in the world are a continually repeated, direct experience, and so their trust is continually renewed, even if physical need seems to stand firmly in their way.

Finally, religion, as I have already said, is of crucial importance for art. If, as we have done, we call religion simply the spiritual form into which a human community grows, then it almost stands to reason that art must be an expression of religion. A look at the history of the various cultures tells us that we are in fact able to establish most directly the spiritual form of an earlier age from its still existent works of art, even if we no longer know the religious doctrine in which the spiritual form was expressed.

But all that we have been saying about religion here is well known to you in this gathering. I have only repeated it in order to stress that a representative of science must also recognise the all-encompassing significance of religion if he attempts to reflect on the relationship between religious and scientific truth. The fact that these two truths came into conflict has had a decisive influence on the history of European ideas since the 17th century. The beginning of the conflict is generally considered to be the trial proceedings of the Roman Inquisition against Galileo in 1616, where the issue was the teaching of Copernicus, whose 500th birthday we celebrated a few weeks ago. We shall have to talk in greater depth about this beginning. Galileo had stood for the teaching of Copernicus, according to which—as against the dominant Ptolemaic view of the world—the sun remains in the centre of the planetary system and the earth moves around the sun and revolves in 24 hours. Galileo's pupil Castelli had advanced the thesis that theologians must now set about explaining the Bible in harmony with the proven facts of science. Such a statement could be taken as an attack on Holy Scripture, and the Dominican fathers Caccini and Lorini brought the matter before the Roman Inquisition. In the verdict of 23 February 1616, the two statements attributed to Copernicus were in the indictment declared to be philosophically absurd and heretical, viz. "The sun is the centre of the world and is therefore immobile," and secondly, "The earth is not the centre of the world and not immobile, but it revolves daily." With Pope Paul V's assent, Cardinal Bellarmine was entrusted with the task of exhorting Galileo to give up Copernicus' teaching. Were he to refuse, the cardinal was to order him not to teach or defend or discuss such a doctrine. Galileo bowed to this order loyally to some extent, but considered he could continue his studies openly, especially after the accession of Pope Urban VIII. After the publication of the famous polemic "Dialogue" in 1632, there was a second trial in which Galileo had to abjure the Copernican doctrine in all forms. The details of the trial need not interest us today, nor the human inadequacies which were a factor on

both sides. But we can and must inquire into the deeper reasons for the conflict.

First it is important to be clear in one's own mind that both sides believed they were right. Both the church authorities and Galileo were equally convinced that high values were in danger and that it was their duty to defend them. Galileo had experienced, as I mentioned earlier that through careful observation of phenomena on earth and in the heavens, the dropping of stones or the movement of planets, mathematical laws become apparent which make visible a previously unknown degree of simplicity in phenomena. He had recognized that this simplicity produces a new possibility of understanding, and that we can produce partial systems in the eternal order of the world of phenomena. The Copernican interpretation of the planetary system was simpler than the traditional Ptolemaic one; it permitted a new kind of understanding, and Galileo wished under no circumstances to give up this new insight into the divine order. The church, conversely, believed that there should be no tampering with the view of the world accepted for centuries as being an integral part of Christian thinking unless there were very compelling reasons for so doing. Neither Copernicus nor Galileo could produce such compelling reasons. In fact, the first thesis of the Copernican teaching, which was at issue here, was quite definitely false. Today's science would not say that the sun is in the centre of the world and thus immobile. In the second thesis dealing with the resting position of the earth, one would first have to explain what the words "rest" and "movement" mean. If one accords them an absolute meaning, such as naive thinking does, then it is simply a definition that the earth is at rest. At any rate we use the word in this way and in no other. If we realize that the notions have no absolute meaning and that they refer to the relation between two bodies, then it is of no consequence whether one sees the sun or the earth as at rest or in movement. In that case, there is all the more reason for not altering the view of the world.

Still, we can suppose that the members of the Inquisition had a good idea of the power behind the notion of simplicity which Galileo consciously or unconsciously stood for, and which, on the philosophical plane, was connected with the return to Plato from Aristotle. The judges, too, had obviously the greatest respect for Galileo's scientific authority; thus they did not wish to prevent him from furthering his researches but they did wish to prevent disquiet and uncertainty being carried over into the traditional Christian view of the world, which had had such a decisive role in mediaeval society. Scientific findings, particularly when they are new, are frequently still subject to change; the final judgment can usually only be made after several decades of proof. Why should Galileo not wait with his publication? We thus have to give the Inquisition court credit that they tried to reach a settlement at the first trial and passed a judgment we could readily accept. But after Galileo went

beyond the limits set to his scientific activity in the first trial, the second trial was dominated by those elements in the court which saw force as simpler than attempts at settlement, and so the notoriously hard sentence was passed on Galileo, which later did so much harm to the church.

What store would we set by the argument today that one should not bring disquiet and uncertainty prematurely into a view of the world which, as a part of the spiritual structure of a society, has had an important role to play in making the community's life harmonious? Many radical spirits today would react to this argument with derision; they would point to the fact that it is merely a question of preserving obsolete power structures, and that, on the contrary, one should try to bring about change or dissolution of those structures as quickly as possible. But these radical spirits have to be reminded that the conflict between the sciences and the dominant philosophy is still going on in our times, especially in the totalitarian states where dialectic materialism has been chosen as the basis of thinking. Thus, official Soviet philosophy has had a hard time coming to terms with relativity and quantum theory; there have been severe conflicts of opinion in the matter of cosmology. Finally, in 1948 there was a congress on ideological questions of astronomy in Leningrad which was intended to produce clarification of controversial questions through discussion and agreement, and led the way to a settlement.

Here it is basically a matter, as in the Galileo trial, not of questions of fact, but of the conflict between the spiritual form of society which by its very nature must be static, and the experience and thought-forms of science, which are continually being extended and renewed—that is, of a dynamic structure. Even a society produced by great revolutionary upheavals strives for consolidation and fixation of its spiritual resources, which are to be the permanent basis of the new community. Science, however, strives for extension. Even if science or some other discipline were made the basis of a philosophy of life—and in dialectical materialism something similar is being attempted—it could only be the discipline of past decades or centuries, and with linguistic fixation there would again be the basic situation for a later conflict. So it seems better to make clear through images and parables, from the very start, that the language being spoken is poetic, open to all human values, filled with living symbols, but not scientific.

Despite these general difficulties, we must return to a consideration of the questions of fact in the trial against Galileo. Was it important for the Christian community that Copernicus interpreted certain astronomical observations differently from Ptolemy? Basically it was immaterial for the living of an individual Christian life whether or not there are crystal spheres in the heavens, or whether the planet Jupiter is circled by moons, or whether the earth or the sun is in the centre of the universe. For the individual person the earth did stand in the centre, it

was his living space. But then again it was not all that immaterial. Two hundred years later, Goethe could still speak with fear and admiration of the sacrifices which have to be made if one recognizes the Copernican system. He made them but unwillingly, although for himself he was convinced of the rightness of this teaching. Perhaps the judges of the Roman Inquisition already feared that Galileo's science might produce a dangerous change of direction. They could, of course, not deny that the explorer into nature who, like Galileo or Kepler, discovers mathematical structures in phenomena, makes visible partial structures from the divine order of the world. But this view of the brightly shining parts could perhaps dim the vision of the whole; it could bring about a situation where, as the total context is removed from the individual's consciousness, the community's sense of cohesion suffers and is threatened by decay. As natural living conditions are replaced by processes dictated by technology, alienation is at work between the individual and the community, which produces dangerous instability. In Bertolt Brecht's play "Galileo" a monk says: "The decree against Copernicus has shown me the dangers for mankind inherent in research which is subject to too little control." We do not know if this consideration had a role to play then; but we have since learned how great the dangers are.

We have learned still more from the development of science in the European world moulded by the Christian religion, and I wish to discuss this in the last part of my talk. Earlier I tried to say that in the images and parables of religion we have a kind of language which helps to provide understanding of the ordered world perceptible behind phenomena, and without it we have no ethics and no scale of values. This language is in principle as replaceable as any other language; in other parts of the world there are and there were other languages which in the same way helped men's understanding. But we have been born into a definite linguistic area. This language of religion is more closely related to the language of poetry than to that of science with its aim of precision. Thus the words in both languages often mean something different. The heavens referred to in the Bible have little to do with the heavens into which we send up planes and rockets. In the astronomical universe the earth is only a tiny speck of dust in one of the innumerable milky ways, but for us it is the centre of the world—it is really the centre of the world. Science tries to give its terms an objective meaning. But it is religious language which must avoid this very division of the world into its objective and subjective sides; who would want to say that the objective side was more important than the subjective? We must not confuse both languages; we must think more subtly than people have been accustomed to.

The development of science in the last hundred years has moreover produced this more subtle thinking in its own field. As we no longer make the world of direct experience the subject of our research, but

a world into which we can only penetrate with the means of modern technology, the language of everyday life is no longer adequate. We can of course finally succeed in understanding this world by representing its formal structures in mathematical formulae; but when we wish to talk about it we must make use of images and parables, almost as in religious language. So we have learned to be more careful in our use of language and have appreciated that seeming contradictions can be rooted in the inadequacy of the language. Modern science has brought to light laws of wide scope, much more so than those with which Galileo and Kepler had to do. But it has been proven that with the width in the interpretation of the phenomena the degree of abstraction grows and with it the difficulty of comprehension. Even the demand for objectivity, which for a long time was considered a prerequisite of all science, has been limited in atomic physics by the fact that it is no longer possible to separate a phenomenon to be observed completely from its observer. Where is our contradiction between scientific and religious truth?

The physicist Wolfgang Pauli once spoke in this context of two polar notions which have both been extremely fruitful in the history of human thought, although neither of them corresponds to a genuine truth. The one extreme is the notion of an objective world, which moves according to laws independent of any observing subjects in time and space; it was the guiding principle of modern science. The other extreme is the notion of a subject which experiences the unity of the world mystically and which is not confronted by any object nor objective world; this was the guiding principle of Asiatic mysticism. Our thinking moves somewhere in the middle between these two extreme notions; we have to bear the tension produced by the poles.

Part of the careful process of keeping religious and scientific language apart is also a matter of avoiding a weakening of their content through intermingling them. The correctness of proven scientific results cannot sensibly be doubted by religious thinking, and, vice versa, the ethical demands which proceed from the heart of religious thinking should not be dissolved by extreme rational arguments from the sphere of science. There is no doubt that, with the extension of technological opportunities, there have arisen new ethical questions which cannot easily be solved. I mention as an example the question of the responsibility of the researcher for the practical use of his research findings, or the even more difficult question from the sphere of modern medicine, as to how long a doctor should or may prolong the life of a dying patient. Consideration of such problems has nothing to do with a softening of ethical principles. Nor can I imagine that such questions are to be answered with merely pragmatic expedients. Perhaps it will be necessary here to take a total view of the matter: the basic human attitude expressed in the language of religion from which the ethical principles derive.

Perhaps today we can again distribute more correctly the weights which have been put out of place by the enormous spread of science and technology in the last hundred years. I mean the amount of weight which we accord to the material and spiritual considerations in human society. Material considerations are important, and it was the duty of society to remove the material need of great masses of people when technology and knowledge afforded the opportunity. But when this had happened there was still a great deal of misery left, and we have seen how much the individual, whether he consciously asks for it or takes it for granted, needs the protection which the spiritual side of a community can afford him. It is here that perhaps our most important tasks lie. If there is a great deal of unhappiness in today's young students, the reason for it is not material need, but that lack of trust which makes it hard for the individual to give his life a purpose. So we must try to overcome the isolation which threatens the individual in a world dominated by the practical demands of technology. Theoretical consideration of questions of psychology or the structure of society will not be much help unless we succeed in regaining a natural balance in the intellectual and material spheres of life, through practical action. It will be a matter of reviving in everyday life the values enshrined in the spiritual side of the community and giving them so much illuminating power that people take them as a guide for their own individual lives.

But it is not my task to speak about society; rather I was supposed to deal with the relationship of scientific truth to religious truth. Science has made great progress in the last hundred years. The wider spheres of life, about which we speak in the language of our religion, have perhaps been neglected in the process. We do not know whether we will succeed in expressing the spiritual form of our future societies in the old religious language. A rational game with words and terms is of little help; honesty and directness are the things we need most. But, as ethics are the basis for man's communal existence, and ethics can only be gained from that basic human attitude which I called its spiritual aspect, we must all make every effort to agree with the young generation on a common human attitude. I am convinced that we can succeed if we again find the right balance between both truths.